CN9501675

QUALITY ASSURANCE FOR EXTERNAL PERSONNEL MONITORING IN NUCLEAR INDUSTRIAL FACILITIES, CNNC

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I INTRODUCTION

More than 6000 personnel are currently being monitored for occupational exposure in CNNC, China. Personnel monitoring is one of the important items of radiation protection. The data of individual dose are not only indispensable for radiation safety assessment but also the basis for radiation protection measures to be taken. Possibly, it could provide basic information for epidemiological studies, optimization procedure of radiation protection (risk/benefit analyses) and medical or legal purposes. Obviously, personnel monitoring and its quality assurance are very significant.

The objectives of quality assurance and major measures of quality assurance used in CNNC have been introduced and discussed in this paper.

II. OBJECTIVES OF QUALITY ASSURANCE

Quality assurance in personnel monitoring may be described as comprising those planned and systematic actions that are necessary to provide adequate confidence in the results of a monitoring programme. Quality assurance includes quality control which in tern involves all actions by which the adequacy of equipments, instruments and procedures is assessed against established requirements. [1]

According to the national basic radiation safety standard "RADIATION PROTECTION REGULATION" and "GENERAL RULE OF QUALITY ASSURANCE FOR IONIZING RADIATION MONITORING" quality assurance in radiation monitoring shall be quaranteed in every step of whole process from establishment of a monitoring programme to assessment of monitoring results. Any monitoring programme shall include programme of quality assurance to ensure that instruments and equipments will work properly, measurement procedures will be established and implemented, assessment of monitoring results will be correctly carried out, monitoring records will be adequately and timely kept, the accuracy will be quaranteed and errors will be controlled. [2,3]

III. QUALITY ASSURANCE PROGRAMME

Quality assurance in individual monitoring should include:

- Perfect quality assurance organization;
- Selection and training of dosimetric service personnel;
- Performance, quality and management of dosimeters; readers and instruments;
- Calibration procedures and frequency of dosimetric system;

- Periodic test procedures of dosimetric system;
- Maintenance procedures and frequency of dosimeters, instruments and equipments;
- Standard sources and reference radiation used for calibration;
- Quality control measures for dosimetric system;
- Distribution, collection and management of dosimeters;
- Effective internal quality systems and administration.

IV. MAJOR MEASURES FOR QUALITY ASSURANCE

4.1 Well trained and experienced dosimetric service personnel

All of the persons who are engaged in individual monitoring should be trained with principles of radiation protection and special knowledge of personnel monitoring, be familiar with dosimetric system, calibration technique and procedures, measurement technique and procedures. They have to pass the special exam and be authorized according to their technical level and experience before dealing with individual monitoring.

4.2 Periodic test, calibration and maintenance of dosimetric system

It is required that the periodic test procedures, technical guides, calibration and maintenance procedures for all dosimeters, instruments and equipments should be established and followed to ensure that they work properly.

4.3 Personnel dosimeter intercomparision

Personnel dosimetry intercomparision is the significant activity to ensure reliability and comparability of monitoring results.

Experience has shown that the performance test of dosimetry system for personnel monitoring through national or international intercomparision programmes could be the best check on quality assurance standard of an individual monitoring service centre.

Personnel Monitoring and Management Service Centre, CNNC being in charge of quality assurance in personnel monitoring, on behalf of our country participated in all the IAEA/RCA projects on intercomparision of personal dosimeters.

Three phases of IAEA/RCA intercomparision study carried out during 1990-1992 provided a good opportunity for us to re-check our calibration sources and calibration technique and were designed to check the performance of dosimetric system on new ICRU operational quantities as well as exposure.

The typical results of field reference value check and intercomparision measurement in phase III are given in table 1 and table 2 respectively.

Table 1 Calibration Radiation Field Reference Value Check

GD NO*	Distance mm	Delivered Value mR	Estimated Value mR	Deviation ** %
7939	2000	100	98.4	-1.56
7439	2000	100	98.4	-1.06
7492	2000	100	98.4	-2.17

* Three glass dosimeters sent from JAERI, JAPAN were used to check the reference radiation.

** $$\text{Deviation (\%)} = \frac{\text{Estimated Value - Delivered Value}}{\text{Delivered Value}}$$

Table 2 IAEA/RC Dosimeter Intercomparision Phase III
- Irradiation Date and Measurement Results *

Irradiation Number	Source. Effective Energy (KeV)	Distance (m)	Delivered Dose (mSv or mR)	Estimated dose (mSv or mR)	Deviation (%)
1	X-Ray 60.4	2.5	6.27# mSv	6.44 mSv	+2.7
2	^{137}Cs 662	2.32	0.08 mSv	0.82 mSv	+2.5
3	^{60}Co 1250	2.48	900 mR	1035 mR	+15
4	X-ray 203	2.5	144 mR	134 mR	-6.9
5	X-ray 60.4	2.5	380 mR	372 mR	-2.1
6	^{226}Ra Eff.830	0.7	65 mR	77.5 mR	-19

* Irradiation data and delivered doses were given by JAERI

Our results of the intercomparision have shown that all kinds of dosimeters used in the three phases of intercomparision meet the demand of our national standard. [4] However, our focus point for the intercomparision study was to find some deficiencies in personnel monitoring. through these three phases of intercomparision the reference sources used for calibrating dosimeters have been examined and some deficiencies in calibration equipment.

calibration methods and procedures, and design of dosimeters have been found. They are being improved.

In addition, domestic intercomparision of dosimeters organized by the Service Centre had been carried out.

4.4 "Parallel measurement" in personnel monitoring

In the nuclear facilities, CNNC, some workers preselected in a certain post will wear both dosimeters issued by the facilities themselves and Personnel Monitoring and Management Service Centre. If the differences of the measurement results for the two dosimeters, over the limits preset, the reasons have to be analyzed and countermeasures should be taken to ensure the reliability and comparability of the individual monitoring.

4.5 Metrological Dissemination

All of the radiation sources and reference radiation fields used for calibrating dosimeters in the nuclear facilities, CNNC shall be certificated by the competent metrological authority and could be traced to the relevant national standards.

The 30-300keV X-ray reference radiation and 6-100keV Kx-fluorescent reference radiation used for calibration, test and intercomparision study in Personnel Monitoring and Management Service Centre were established according to IS04037 and have been certificated as a secondary standard by the competent national metrological authority. Two isotope sources, Cs-137 and Co-60 are also traceable to the relevant national standard.

Reference

[1] Bohm, J et al.
Radiation Protection Dosimetry 40, 17-26 (1992)

[2] GB8703-88
National Standard "Radiation Protection Regulation" (1988)

[3] GB8999-88
National Standard "General Rule of Quality Assurance for Ionizing Radiation monitoring" (1988)

[4] Zhang Yansheng et al.
IAEA/RCA Intercomparision of Personal Dosimeters
Results and Discussion unpublished. (1992)

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